Wils. Soc. Bull. 18:83–86, 1990

BEP 1990-00
AUTHOR FILE

RED-WINGED BLACKBIRD FEEDING BEHAVIOR ON TWO SWEET CORN CULTIVARS

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Red-winged blackbirds (*Agelaius phoeniceus*) depredate ripening corn (*Zea mays*), especially in fields located near late summer roost areas (Dyer 1967). Ears of sweet corn are especially susceptible to value loss from even a small amount of bird damage. Bernhardt et al. (1987) described techniques used by 3 species of blackbirds (Icterinae) and starlings (*Sturnus vulgaris*) to open the husk and consume ripening corn kernels. Dolbeer et al. (1986, 1988) showed that morphological characteristics of the husk influenced the amount of damage done to sweet corn by birds in aviary and field tests. The objective of this aviary study was to quantify the feeding behavior of redwings when presented 2 cultivars of sweet corn with major differences in husk characteristics. The intent was to determine how morphological characteristics of the husk influence feeding behavior.

METHODS

We planted 2 cultivars of sweet corn, Gold Dust or cultivar 22 (Agway Seed Company, Syracuse, N.Y.) and Jazz or cultivar 23 (Roger Bros. Seed Company, Boise, Id.), in 6-row by 75-m plots on 3 June 1988. Cultivar 22 has been resistant to bird damage in previous aviary and field tests whereas cultivar 23 has been susceptible (Dolbeer et al. 1986, 1988). We marked with spray paint at 2-day intervals from 18 to 30 July all plants with newly silked ears in rows 2 to 5 of each plot. A different color was used each day so we could use ears of the same silking date in the cage tests described below.

We placed 32 after-hatching year red-winged blackbirds caught in mist nets in July 1988 in Erie County, Ohio, in 8 cages, 1.5 × 1.0 × 0.5 m in size. These adult birds were most likely experienced at feeding on ears of corn because 100% of an independent sample of 62 red-winged blackbirds collected at the same locations in 1988 contained ripening corn (Okurut-Akol 1989). We placed 4 females in each of 4 cages, and 4 males in each of the remaining 4 cages. The cages were equally supplied with perches, water, and grit; and each was supplied with mixed grain except during observation periods. All birds were fed fresh sweet corn of another cultivar prior to the experiment. Woronecki et al. (1987) provide a detailed description of the aviary design and general testing procedure.

We presented ears from cultivar 23 alone in each of the 8 cages on 9 August 1988 in a 1-choice test. We presented cultivars 22 and 23 together in each cage in 2-choice tests on 11 and 13 August. We presented cultivar 22 alone on 15 August. Cultivar 23 was presented first to all birds because an insufficient number of ears of the later maturing cultivar 22 were available on 9 August. Because all birds had experience in feeding on ripening corn, we believed any bias caused by the order of presentation would be minimal.

On test days ears of corn, 18 days past silking, were picked with husk and shank intact at 0800 hour. All ears of the proper maturity (color) encountered on a row were picked until the number needed for the tests was obtained. Four ears were placed on each of 8 racks, oriented as they grew on the stalks and separated by 0.2 m. In 2-choice tests, ears of each cultivar were alternated on the rack, with the initial ear randomly assigned. Two cages were tested simultaneously. All food was removed from 2 of the 8 cages at about 0830 hour, 36 minutes before inserting the racks of corn. Two observers, 1 for each cage, began their observations within 1 minute of rack insertion using 7X binoculars from blinds 8 m from the cages. Each ear was observed in turn for 5 seconds at 30-second intervals, the timing being noted by use of a tape recorder playing musical tones. After 20 5-second observations the tape was rewound and observations continued until 60 observations were completed. This took about 34 minutes to complete. At each 5-second interval, the major activity of any bird interacting with the observed ear was recorded using a system developed earlier (Bernhardt et al. 1987; Table 1). The estimated point of beak contact with the ear in 1/10 segments from the tip of the ear was also recorded.

At the end of the 60 observations, the 2 racks were removed and racks with fresh corn were placed in 2 more cages whose food had been removed 36 minutes earlier. Observations were repeated as before until all 8 cages had been observed. Observations were completed by 1200 hour. The order of cage observation was rotated during the 4 observation days so that each cage was observed equally throughout the morning.

We measured the minimum length (mm) of husk extension beyond the cob tip for each ear before the rack was placed in the cage. After all 8 cages had been observed, each ear had that portion of the husk extending beyond the cob tip cut off and the remaining husk, from the butt of the ear to the cob tip, removed. These husk portions were placed in a drying room (~35 C) for 1 month and then weighed. Percent bird damage on each ear was visually estimated at the time the husk was removed (Woronecki et al. 1980).

Chi-square tests were performed to determine if frequency of feeding behaviors by redwings differed when attacking resistant and nonresistant ears of corn. Differences between the 2 cultivars in damage, cultivar characteristics, and beak placement on the ear were compared with t-tests (paired observations for damage, unpaired observations for characteristics and beak placement).

RESULTS

Husk Characteristics

The minimum distance which the husk extended beyond the cob tip averaged 79 ± 11 mm for 64 ears from cultivar 22 and 12 ± 19 mm for 64 ears from cultivar 23 ($t = 24.0$, 126 df, $P < 0.001$). Fifteen of 64 ears of cultivar 23 had negative husk extensions. Dry weight of husk from cob butt to tip averaged 12.5 ± 3.3 g for cultivar 22 ears, and 4.7 ± 1.2 g for cultivar 23 ears ($t = 17.7$, 126 df, $P < 0.001$). Weight of the husk extending beyond the cob tip averaged 2.4 ± 0.4 g for cultivar 22 ears and 0.5 ± 0.1 g for cultivar 23 ears ($t = 2.9$, 126 df, $P < 0.001$).

Bird Damage and Behavior

When the 2 cultivars of corn were presented to the birds at the same time (2-choice test), ear access activities were recorded in 56 of 480 (12%) observations for ears of cultivar 22 compared to 171 of 480 (36%) observations for ears of cultivar 23 ($\chi^2 = 76.3$, 1 df, $P < 0.001$). No (0 of 480) feeding activities were observed for cultivar 22 during 2-choice tests compared with 160 of 480 (33%) observations for cultivar 23 ears ($\chi^2 = 192.0$, 1 df, $P < 0.001$) (Table 2). During 1-choice tests the percent of observa-

Table 1. Blackbird feeding behavior codes used in recording response to ears of 2 sweet corn cultivars in aviary tests, Erie County, Ohio, 1988.

Non-feeding categories
- 0 = No bird present on ear
- + = Bird present on ear, not feeding or attempting to feed

Access activity categories
- 11 = Pecking motion with closed beak or only slightly open, directed at husk or silk not resulting in grasping, flipping or levering
- 12 = Head flip (dorsally directed) of husk or silk with upper beak surface
- 13 = Head pull (ventrally directed) of husk or silk with ventral beak surface
- 14 = Sideways head pull or flip with side of beak
- 15 = Gaping open husk or silk by opening beak
- 16 = Grasping of husk or silk with beak
- 17 = Head lever with forward rotation of head pivoting around tip of beak or pushing beak anteriorly either resulting in head lever or not

Feeding activity categories
- 21 = Feeding peck beneath or behind husk or silk
- 22 = Feeding peck through existing hole or slit in husk or silk, not beneath husk but in contact with husk or silk
- 23 = Feeding peck completely unencumbered by husk or silk

Table 2. Red-winged blackbird feeding responses (No.) to ears of 2 sweet corn cultivars in 2-choice and 1-choice aviary tests, Erie County, Ohio, 1988.

	2-choice test		1-choice test	
Feeding activity/codes	Cultivar 22	Cultivar 23	Cultivar 22	Cultivar 23
Non-feeding/				
0	329	113	260	226
+	95	36	97	56
Access/				
11	24	52	37	20
12	2	1	2	1
13	1	1	0	2
14	1	1	0	1
15	6	72	27	55
16	20	6	36	2
17	2	38	10	36
Feeding/				
21	0	42	0	14
22	0	101	11	61
23	0	17	0	6
No. of responses	480	480	480	480

tions that were of access activities did not differ ($\chi^2 = 0.14$, 1 df, $P > 0.10$) between cultivars; they were 23% and 24% for cultivars 22 and 23, respectively. However, feeding activities were recorded for only 11 of 480 (2%) observations of cultivar 22 compared to 81 of 480 (17%) for cultivar 23 ($\chi^2 = 58.9$, 1 df, $P < 0.001$). Mean loss of kernels was greater for cultivar 23 than cultivar 22 in both 1-choice (3.7 vs. 0.3%, $t = 6.7$, 7 df, $P < 0.001$) and 2-choice (7.8 vs. 0.0%, $t = 8.7$, 7 df, $P < 0.001$) tests.

Category 16, grasping of husk or silk, accounted for 33% of access activity (56 of 168) for birds trying to open cultivar 22 ears in all tests but was only 3% (8 of 288) of the access activities of birds attempting to feed on ears of cultivar 23 ($\chi^2 = 82.0$, 1 df, $P < 0.001$). We noted that the birds trying to open cultivar 22 ears often grasped silk from the narrow silk channel at the extreme tip of the ear, an activity not observed in cultivar 23.

The gaping technique (category 15), wherein a bird inserted its beak into or under the husk and then opened the beak to enlarge or create an opening, was used in 127 of 288 (44%) access responses for cultivar 23, significantly ($P < 0.001$) greater than for cultivar 22 where gaping was used in 33 of 168 (20%) access responses ($\chi^2 = 27.8$, 1 df). Birds often gaped in natural openings, such as under loose husks or in the silk channel, but they also gaped in openings created by simple pecking (category 11). One female bird was observed performing 3 successive gapes, each about 1 cm lower than the previous gape, during a 5-second observation period on an ear of cultivar 23. This had the effect of opening a long slit in the husk.

Head levering and forward pushing of the beak under the husk (category 17) was used in 26% (74 of 288) of access attempts on cultivar 23, which was greater than the 7% (12 of 168) of access attempts on cultivar 22 ($\chi^2 = 23.9$, 1 df, $P < 0.001$). We noted that attempts to head lever or to "bulldoze" with the head were often made at the ligules of flag leaves. This technique was most successful in creating openings in the somewhat looser and lighter husk of cultivar 23 ears. One female bird perched on an ear of cultivar 23 did 3 consecutive head levers, each about 0.5 cm lower on the ear.

Birds accessing or feeding on kernels of cultivar 22 directed their efforts significantly ($P < 0.01$) closer to the ear tip than did birds attacking cultivar 23 ears in both 2- and 1-choice tests (Table 3). Overall, the birds' beaks contacted cultivar 22 ears at an average position (in 1/10 of ear intervals from ear tip) of 1.6 compared to 2.6 for cultivar 23 (Table 3).

DISCUSSION

Our data indicated that birds encountering ears of corn that were difficult to open quickly redirected their efforts if an alternate, more easily accessed, cultivar was available. However, when no alternative cultivar was available, the birds made about the same number of access attempts on the resistant cultivar 22, as they did with the susceptible cultivar 23. Yet, the birds were generally unsuccessful in gaining access to the kernels of cultivar 22, so the feeding activities and subsequent damage were significantly less than in cultivar 23.

The preferred access techniques used by the birds on cultivar 23 included the head lever (Table 1, category 17) which would work well at any level on the ear where a flap or looseness for beak insertion was present. The husk or silk grasp (category 16), among the preferred techniques for opening cultivar 22 ears, was only usable on these ears in the extreme upper portion. Our data on beak placement reflected this.

Gaping and head levering (categories 15 and 17) were favored by birds attempting to open ears of cultivar 23. This suggests exploitative aspects of the birds' feeding behavior. Corn ears with tight husks which resist these techniques were deserted by the birds in favor of ears susceptible to gaping and head levering.

Table 3. Mean point of ear contact by beak in 1/10 of ear intervals from ear tip for blackbird feeding responses to ears of 2 sweet corn cultivars in aviary tests, Erie County, Ohio, 1988.

Cultivar	2-choice test			1-choice test			Combined tests		
	$\bar{x}$	SD	n	$\bar{x}$	SD	n	$\bar{x}$	SD	n
22	1.2[a]	0.4	56	1.8[b]	0.9	123	1.6	0.9	179
23	2.8[a]	1.0	331	2.2[b]	1.3	198	2.6	1.2	529

[a] $t = 11.7$, 385 df, $P < 0.01$.
[b] $t = 3.0$, 319 df, $P < 0.01$.

The grasping technique (category 16) was used by birds to attempt to reach kernels in ears of cultivar 22 but not in ears of cultivar 23. Perhaps by grasping and removing silk from the tightly packed silk channel the birds attempted to create an opening in cultivar 22 ears where the beak could be inserted for use of another technique, such as gaping or head levering. Pecking at the husk or silk channel (category 11) could quickly create an opening in a cultivar 23 ear with a light, open husk that was easily penetrated. Apparently, pecking was not productive in creating openings for cultivar 22 ears; hence, the birds attempted to penetrate through the silk.

The results of this experiment provide insight into previous findings that resistance of sweet corn cultivars to bird damage is positively correlated with the weight and length of ear husk extension (Dolbeer et al. 1986, 1988). Apparently, long and heavy husks make it difficult for blackbirds to peck through to the kernels. Perhaps small silk channel diameter and husk tightness around the ear are also important in preventing blackbirds from gaining an entry hole into an ear. These factors could be further evaluated by physically creating loosened husks and larger silk channels on ears of a normally tight-husked cultivar and observing blackbirds feeding on these altered ears in comparison with unaltered ears. The goal would be to further refine our understanding of the factors that imbue bird resistance to cultivars of corn.

Acknowledgments.—We thank R. A. Dolbeer, P. P. Woronecki, G. L. Baldwin, and B. J. Bly for assistance.

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Received 24 August 1989.
Accepted 11 October 1989.